

Applicant: Preston Crow, *et al.*
U.S.S.N.: 10/644,458
Filing Date: August 20, 2003
EMC Docket No.: EMC-99-026CON1

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REMARKS

This amendment is in response to the Non-Final Office Action mailed April 18, 2006, wherein Claims 1, 2, 4-6, 13, 14, and 16 were rejected. Claims 1, 2, 4-6, 13, 14, and 16 remain pending in the application. The applicants respectfully request further examination and allowance of pending Claims 1, 2, 4-6, 13, 14, and 16 in view of the arguments below.

Claim Rejections – 35 U.S.C. § 103

Independent Claim 1 was rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,161,111 (“Mutalik”). The examiner asserts that Mutalik teaches “each extent having a field to indicate whether the extent is an indirect extent, a hole extent or a direct extent.” The examiner further asserts that although Mutalik “does not clearly teach . . . indirect and direct extents,” its use of a “current extent offset pointer implied that it is pointing to some extents directly or indirectly.” This rejection is respectfully traversed.

Independent Claim 1 recites, in addition to other features, that “a portion of the rows storing extents point[] to data blocks, each extent having a field to indicate whether the extent is an indirect extent, a hole extent, or a direct extent.” The applicants respectfully assert that Mutalik does not teach or suggest the “field to indicate whether the extent is an indirect extent, a hole extent, or a direct extent” because its system only uses a single type of extent and it therefore does not need to use any field to indicate the type of a particular extent.

The applicants respectfully assert that Mutalik does not teach or suggest the use of indirect extents. The applicants’ invention uses indirect extents as part of a file system to enable a file to be expanded without the need to move previously stored file segments. In the present invention indirect extents may be placed at any location in an inode. The indirect extent points to

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another data block that is used to store more extents for a file. In this manner, extents for any number of data blocks can be inserted at any point within a file. (Specification, page 7, lines 15-23)

Matalik never teaches or suggests anything similar to the indirect extents used in the present invention. Instead, Matalik teaches only the use of direct extents in its file map entries, which are the rough equivalent of the inodes used in the present invention. Each file map has an extent descriptor list. Matalik describes its extent descriptor list as having "a plurality of extent descriptors, the series of extent descriptors are in the order corresponding to the series of extents on which the file associated with the file map entry are stored. Each extent descriptor contains a plurality of fields, namely, a device list index field . . . , a starting block identifier field . . . , and a number of blocks field." Matalik never suggests that any of the entries in the extent descriptor list could be pointers to *another list* that contains extent descriptors, which is how the indirect extents are used in the present invention. (Matalik Column 7, line 45 – Column 8, line 27)

The examiner asserts that the use of a "current extent offset pointer" in Matalik can be combined with the other teachings of Matalik in order to render the present invention obvious. However, the "current extent offset pointer" does not teach or suggest anything similar to an indirect extent. The "current extent offset pointer" in Matalik is not used as part of the file system or file map entry. Instead, it is only used as part of a control module to access a file being opened. Only one current extent offset pointer is used for this purpose, as opposed to the possible use of many indirect extents in the present invention. Furthermore, the current extent offset pointer does not point to an area of storage that contains a list of more extents for a file. It does not even point to a single extent, directly or indirectly. Instead, it is used to point to a particular

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U.S.S.N.: 10/644,458
Filing Date: August 20, 2003
EMC Docket No.: EMC-99-026CON1

piece of data within the extent currently being accessed by the control module. The current extent offset pointer therefore operates in a totally different manner than the indirect extents in the present invention and is used for a totally different purpose. (Mutalik Column 10, lines 40-54 and Column 11, lines 30-33)

Furthermore, Mutalik does not teach or suggest the use of hole extents. Hole extents are used in the applicants' invention to reserve data blocks for use by a file before the blocks are actually needed (Specification page 6, lines 28-30). The examiner does not indicate any teaching in Mutalik that has this functionality or serves this purpose.

Mutalik therefore only teaches the use of direct extents, and its use of a "current extent offset pointer", alone or in combination with its other teachings, does not teach or suggest the use of indirect extents as used by the present invention. Because Mutalik does not teach or suggest the use of indirect extents nor the use of hole extents, it certainly does not teach the use of a field to indicate whether a particular extent is an indirect extent, a hole extent, or a direct extent, which is part of the applicants' invention claimed in Claim 1: no such field is necessary or would even be useful. The applicants therefore respectfully request reconsideration and removal of the rejection of Claim 1 for obviousness over Mutalik.

Claims 2, 4-6, 13, and 16, including independent Claims 5 and 13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Mutalik in view of U.S. Patent No. 5,764,972 ("Crouse").

With respect to Claims 2 and 4, because both claims depend from Claim 1, the applicants respectfully assert that these claims are allowable for at least the same reasons as Claim 1, as discussed above.

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U.S.S.N.: 10/644,458
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With respect to independent Claims 5 and 13, the examiner asserts that "Mutalik teaches a field for indicating that the extent is one of an indirect extent and a direct extent." The examiner further asserts that "[o]ne having ordinary skill in the art would have found it motivated to utilize the use of any portion of the extents to be indirect extents as disclosed [by Crouse]" This rejection is respectfully traversed.

Independent Claims 5 and 13 both recite, in addition to other features, that each of the extents has "a field for indicating that the extent is one of an indirect extent, a hole extent, and a direct extent." The applicants respectfully assert that neither Mutalik nor Crouse, alone or in combination, teach or suggest the claimed invention because their systems do not use any field to indicate the type of a particular extent. In Mutalik, no field is used to indicate the type of the extents because, as discussed above, only one type of extent is taught. In Crouse, no field is used to indicate the type of the extents because, as discussed below, no hole extent is taught and the type of the extent is determined by its position in an inode.

The applicants respectfully assert that neither Mutalik nor Crouse, alone or in combination, teach or suggest the use of any of the extents in an inode as indirect extents. As described above, Mutalik only teaches the use of direct extents. Although Crouse does teach the use of indirect extents, it does not teach or suggest that any of the extents in an inode may be used as indirect extents, regardless of their position in the inode. The indirect extents used in Crouse are described in detail in U.S. Patent No. 5,454,103 ("Coverston"), which is incorporated by reference into Crouse (Crouse Column 14, lines 40-46).

Coverston uses three different levels of indirect extents. There is only a limited number of each of these extents in an inode for a file, and they are limited to the last extents of the inode.

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U.S.S.N.: 10/644,458
Filing Date: August 20, 2003
EMC Docket No.: EMC-99-026CON1

There is no field to indicate that a particular extent is an indirect one because the type of each extent is understood from its location in the inode. (Coverston Column 6, line 61 – Column 7, line 16)

It is clear that Coverston does not teach or suggest the use of any of the extents in an inode as indirect extents from its discussion of how a file is stored in extents. Files are stored in blocks mapped by first the small direct extents, then the large direct extents, and then by extents in the data blocks pointed to by the indirect extents. Only after all of the small and large direct extents are used are the indirect extents in Coverston used. (Coverston Column 7, line 61 - Column 8, line 38). This is in contrast to the ability of the present invention to use indirect extents at any point in an inode.

Furthermore, Coverston does not motivate the use of indirect extents at any point in an inode. Coverston favors the use of all of the direct extents prior to the use of any of the indirect extents because it "favors the allocation of contiguous areas of physical storage whereby enhancing access performance and improving the utilization of storage resources" (Coverston Column 8, lines 22-24). The present invention does not require the allocation of contiguous areas of physical storage. Instead, in order to make it easier to grow a file in its middle, the present invention allows the use of indirect extents to insert blocks of data into the middle of a file that are stored in areas of physical storage that are separate from the previously stored data. This enables the file to grow easily because none of previously stored data would need to be rewritten.

For an illustrative example of this, see Figures 8A and 8B of the present application. In Figure 8B new data has logically been inserted between consecutive data blocks 114 and 115. The data in blocks 117 and 118 is logically between the data in blocks 114 and 115, but is stored

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EMC Docket No.: EMC-99-026CON1

in a location in physical storage that is separate from both of the original data blocks. The present invention therefore expands upon the use of contiguous blocks of memory required by Coverston in order to make it easier to grow large files. The file system described in Coverston and incorporated into Crouse, has the problem, without recognizing that it is a problem, of large files being cumbersome to expand. That problem, among others, is solved by the present invention at the expense of the result favored in Coverston of the use of contiguous blocks of data. Coverston and Crouse cannot, therefore, be said to motivate the solution to this problem that is presented by the present invention.

Furthermore, neither Mutalik nor Crouse, alone or in combination, teaches or suggests the use of hole extents. Hole extents are used in the applicants' invention to reserve data blocks for use by a file before the blocks are actually needed (Specification page 6, lines 28-30). The examiner does not indicate any teaching in Mutalik or in Crouse that has this functionality or serves this purpose.

Crouse therefore only teaches the use of indirect extents that are identified by their predefined locations within an inode (e.g. the last three rows) rather than by a field in the extent and does not teach the use of hole extents at all. Mutalik, as discussed above, only teaches the use of direct extents. Because neither Mutalik nor Crouse, alone or in combination, teach or suggest the use of indirect extents at any location in an inode or the use of hole extents, they do not need to use a field to indicate whether a particular extent is an indirect extent, a hole extent, or direct extent, which is part of the applicants' invention claimed in Claims 5 and 13: no such field is necessary or would even be useful. The applicants therefore respectfully request

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EMC Docket No.: EMC-99-026CON1

reconsideration and removal of the rejections of Claims 5 and 13 for obviousness over Mutualik in view of Crouse.

With respect to Claims 6, 14, and 16, because Claim 6 depends from Claim 5 and Claims 14 and 16 depend from Claim 13, the applicants respectfully assert that these claims are allowable for at least the same reasons as Claims 5 and 13, as argued above.

In view of the foregoing, the applicants assert that the application is in condition for allowance and respectfully request favorable reconsideration.

In the event the examiner deems personal contact desirable in the disposition of this case, the examiner is invited to call the undersigned attorney at (508) 293-7835.

Please charge all fees occasioned by this submission to Deposit Account No. 05-0889.

Respectfully submitted,

7/18/06
Date

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